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America's Quality Line of Sockets, Shields and World-Famous Varicon Connectors

FINAL ENGINEERING REPORT
Production Engineering Measure For
Subminiature Packaging Connectors-
From June, 1961 to December, 1962.
Contract No. DA-36-039-SC-85961
Order No. 6016-PP-61-81-81
Placed by P.E.M., USASSA, Phila., Pa.

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TITLE PAGE

Production Engineering Measures

Subminiature Packaging Connectors

Final Report

Reporting: June, 1961 to December 1962

Object of Study:

1. To perform redesign, development and Engineering on a series of 7, 9, 11, 15, 19 and 23 contact connectors, according to Signal Corps technical requirements of SCS-93.
2. To establish a limited production of connectors (Pilot Run).
3. Provide manufacturing planning necessary to expand facilities and personnel to produce 5,000 completed units, male and/or female connectors per 40 hour, 5 day week.

Contract No. DA-36-039-SC-85961

Order No. 6016-PP-61-81-81

Specification No. SCS-93 Dated: 30 September 1960

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ABSTRACT

The development work on this program is based upon the connectors which have been produced previously under an IPS contract. Certain modifications and additions, as well as material changes, cover design and hardware corrections have been included in this contract.

A new redesigned line of the subminiature packaging connectors conform to the technical requirements of SCL-93, dated 30 September 1960.

1. PURPOSE

Perform necessary redesign and Engineering work leading to the development, production and evaluation of the sub-miniature packaging connectors in accordance with SCS-93 of 30 September 1960 and SCIPPR No. 15, dated 1 October 1958.

I. Description of the technical and operational problems.

- A. Background
- B. Design considerations
  - (a) Contacts
  - (b) Insulators
  - (c) Covers
  - (d) Others
- C. Special Tooling
- D. Material
- E. Plating
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II. Pilot Run

- A. Pilot line production
- B. Inspection
- C. Marking and Shipping
- D. Problems encountered in Pilot Run

III. Quality Control Manual

IV. Production planning necessary to produce 5,000 complete units per 40 hours, 5 day week.

2. NARRATIVE AND DATA

(Description of the technical and operational problems)

2.1 Background

The existing packaging connectors have been produced under a preceeding industrial preparedness study contract in accordance with Signal Corps technical requirements SCL-6225. These connectors were designed for use on single sided printed circuit boards of miniaturized equipment sub-assemblies with low power requirements.

The addition of the wire hole tabs for female contacts and the development of the covers for all six sizes of receptacles, specified by subject contract, allows the use of connectors for printed wiring board - to - cable interconnection of miniaturized subassemblies.

Both types of connectors are designed to be capable of 15,000 hours of continuous operation and 1,000 mating cycles without failure.

In view of the fact that the intention of our work was to use the existing tools wherever possible, an important consideration was given to the Elco Manufacturing

Drawings from the previous design concept and correlation of these with corresponding Government prints, showing the new design requirements. It was necessary to determine which parts were useful for subject contract and which parts should be modified or replaced according to the certain changes, assumed by contract.

For identification of the Elco part numbers with the corresponding Government drawings, an identification drawing list was furnished. The list, enclosed at the end of this report, indicates which parts and what quantities are required to assemble a packaging connector, in all applicable sizes.

2.2 Design Considerations

A meeting was set up at Elco Corp. on September 7, 1961 with attendance of Government representatives (See 5.1) to review the required modification and addition in design for new line of subminiature packaging connectors. The problems were analyzed and defined as follows:

2.2.1 Contacts:

Due to the construction of the existing progressive die for the manufacturing of the female contacts, the length

of the redesigned wire tab was shortened to 0.350", instead of 0.370"; location and size of the wire hole, specified by Government drawing, remained unchanged.

Male contacts, designed originally in two sizes, remained the same with the exception of the arm, which fits into the female socket nose. This arm was shortened by 0.031 in., decreasing the vibration of contact to a minimum and providing a more damage resistant male connector.

2.2.2 Insulators

In order to provide for adequate bearing area to support the choice of the guidance hardware, it was necessary to revise the mounting holes in such a manner that the existing relatively small shoulder dimensions on the female ends could be increased. Application of the smaller diameter would best solve the problem, but, the size and form of these holes were determined by the dimensions of (a) RF connector pin, (b) RF connector receptacle, (c) plain guide pin, and (d) plain guide receptacle.

Therefore, the study on RF Microdot plug receptacle CU-32-42 and RF bulkhead receptacle CU-31-69 was undertaken.

It was found that both parts are threaded with #12-32 (0.216" dia) and required mounting holes to be not over 0.220" in diameter. Making the change in diameters from 0.234" to 0.220" we increased the actual supporting area from 0.0061 to 0.0111 squ. in.

Revision of mounting holes to the smaller diameter on the male insulator increased the strength of this part on the ends. This further provided a more easily molded part.

Recognizing the fact that the Government drawings show the overall length of insulators larger by 0.030" in relation to the existing tooling, it was necessary to clarify this problem by Signal Corps Agency. We have mutually agreed to change the drawings to the shorter dimensions.

2.2.3 Covers

Various proposals and models were furnished to answer the requirements of cover design for the sub-miniature packaging connectors.

The concept, given from the previous IPS contract, recommended a one unit hood, with open seams on the sides

and clinching nuts for mounting purpose. This part was designed to be stamped and formed in a progressive die, using aluminum strip material. The approach was found to be correct, although not easily designed. Due to the off-center position of the end holes, we were unable to locate a commercial clinching nut to work within limited space. Also forming of the cover with the open seams provided unsatisfactory results.

First our proposal included the replacement of the open seams by flange and offset arrangement. We dimpled the mounting holes and threaded to the applicable size. If the application of flange and offset arrangement found to be accepted, the threaded dimple holes did not look safe enough in aluminum, and this mounting version was abandoned.

Another model with end holes tapped in extruded parts and spot welded to the sides of the hood, showed satisfactory results. Since the manufacturing of this concept was not economical, the proposal was not approved for further investigation.

Finally, two versions of our proposals were selected and

sufficiently analyzed. The first used standard anglenuts riveted to the cover, and the second, simpler in construction, proposed special nut, dimpled to the sides of the hood. The last version was accepted and the prints were released to tooling design construction.

The cover design provides a stationary clamp, riveted to the top of the hood, and a moving clamp, mounted to the stationary clamp by screw #4-40.

2.2.4 Other Parts

2.2.4.1 Alignment Hardware

Due to the modification of the end holes, as indicated under 2.2.2, it was feasible to increase the bearing surface of female guide pins. The pin is shouldered now by 0.016" each side instead of 0.009" previously, and this provides for better mounting conditions and greater strength.

The same modification was performed on male guide pin, however it was not essential for this part because of it's hexagonal supporting area.

2.2.4.2 Mounting Lug

The width of this part was decreased from 11/32" to 21/64", in order to correct the clearance on plug assembly. Also, the threaded hole was relocated 0.013" off center and a spherical end was added.

2.3 Special Tooling

In general, all our tooling may be classified into three major groups:

(a) Connector Tooling

(b) Cover Tooling

(c) Assembly Tooling

In group (a) we find only modifications from previous contract DA-36-039-SC-72770. In groups (b) and (c) we have the new tooling, designed and constructed for the subject contract.

2.3.1 Connector Tooling (a)

	Manufactured Part	
Tooling Description	Number	Description
4 Cavity Mold (2+2)	6004.3012	Female Insulator
	6004.3062	
4 Cavity Mold (2+2)	6004.3022	Female Insulator
	6004.3052	
4 Cavity Mold (2+2)	6004.3032	Female Insulator
	6004.3042	
2 Cavity Mold	6005.9010	Male Insulator
2 Cavity Mold	6005.9020	Male Insulator
2 Cavity Mold	6005.9030	Male Insulator
2 Cavity Mold	6005.9040	Male Insulator
2 Cavity Mold	6005.9050	Male Insulator
2 Cavity Mold	6005.9060	Male Insulator
Progressive Die	6004.0033	Female Contact
Screw Mach. Tooling	6005.0212	Male Contact
Screw Mach. Tooling	6005.0222	Male Contact
Screw Mach. Tooling	6004.4412	Female Guide Pin
Screw Mach. Tooling	6005.4412	Male Guide Pin
Screw Mach. Tooling	6005.4312	Mounting Lug

Female insulators are produced in compression type molds. Each mold provides four cavities of two different sizes. Total time per cycle 3 minutes.

The molds for male insulators are of the transfer type, having only two cavities of the same size. The contacts are molded in place which extends the manufacturing time for this part.

Female contacts are produced on a progressive die, being stamped from strip coil material. The die is capable of fabricating the contacts with tails from previous tab design and the contacts with the new wire hole tabs.

The male contact is a screw machine part, bent to the proper right-angle shape by a secondary operation. Fabrication of these parts on the Swiss Type Screw Machine, holds the tolerance to ± 0.0005 in diameter.

The allignment hardware and the mounting lug are also screw machine parts, with generally lower tolerance requirements.

2.3.2 Cover Tooling (b)

	COMPONENT PART	
Tooling Description	Number	Description
Progressive Die (6 sizes in one unit)	6004.4915	Hood
	6004.4925	Hood
	6004.4935	Hood
	6004.4945	Hood
	6004.4955	Hood
	6004.4965	Hood
Progressive Die	6004.4615	Stationary Clamp
Progressive Die	6004.4515	Moving Clamp
Screw Mach. Tooling	6004.5015	Mounting Nut

The progressive die for covers is designed in such a manner that all six applicable sizes of the hood may be produced after simple set up operations, for each size of the cover. This is a one unit die consisting of the upper rotary part forming the hood and lower stamping portion adjustable on sides according to the size of the hood. The tool is operated by 60 ton capacity press. The material being stamped and formed, is fed manually into the die.

The clamps are produced on progressive dies, installed

into presses of 20 ton capacity each. Strip material is advanced by hand feed.

2.3.3. Assembly Tooling (c)

	Component Part	
Tooling Description	Number	Description
Staking Tool	6014.0110	Female Connector
	6014.0120	Female Connector
	6014.0130	Female Connector
	6014.0140	Female Connector
	6014.0150	Female Connector
	6014.0160	Female Connector
Dimple Tool	6004.9010	Cover Ass'y
	6004.9020	Cover Ass'y
	6004.9030	Cover Ass'y
	6004.9040	Cover Ass'y
	6004.9050	Cover Ass'y
	6004.9060	Cover Ass'y
Riveting Tool	6004.90	Cover Ass'y
Clinching Tool	6004.90	Cover Ass'y

Staking tool was built to dimple the female contacts into the insulator body. The tool is designed to work within all six connector sizes, being operated by an Air Arbor Press. Starting with the pressure of 100 lbs. for

7 contact connector, the pressure has to be increased by 15 lbs. for each next receptable size.

The dimple tool is a small die, adjustable for all six sizes of covers, which assembles the mounting nuts into the hood. This die, installed in a manually operated Arbor Press, dimples two covers in one press strock.

Two additional tools, very simple in construction, are used - one - for riveting the stationary clamp to the hood, and the other to clinch the standard clinching nuts to the stationary clamp.

2.4 Material

Bill of Materials were prepared in accordance with Department of Defense Forms DD-346 and DD-347. It is a qualitative and descriptive listing of all materials required to produce one thousand completed procurement items. The sub-contracted parts and purchased parts are listed separately on forms DD-347.

The information given below, shows the type of materials used on the contract items.

2.4.1 Contacts

Two materials were selected for this connector series - phosphor bronze, grade "A" with tensile strength of 86000 to 91000 PSI for the female contacts and hard drawn brass rod A.S.T.M. B-134 alloy 6, 0.040 (±0.0005) in diameter, for the male contacts.

2.4.2 Insulators

The female and male insulator bodies are molded of Diallyl Phthalate per MIL-M-14, type SDG-F.

2.4.3 Connector Hardware

Male guide pins have to be made of 3/4 hard brass 70-30 A.S.T.M. B-134, alloy 6. According to the T.A.R. EC#3 of 2 November 1962, 1/2 hard brass was used to expedite delivery on the pilot run.

Phosphor bronze is to be used for lock washers. All other hardware parts shall be made of commercial free machining brass.

2.4.4 Cover

The aluminum 5052-H32 in thickness of 0.032" for hood, and 0.050" for clamps was chosen for materials most suit-

able for cover development. This alloy with tensile strength of 33000 lbs./ sq. in. and yield strength of 28000 lbs./sq. in. found to be better in comparison to alloys 5052-0, 1100 - hard and 3003 - 3/4 hard.

For mounting nuts and rivets we selected aluminum alloy 2017-T4.

Due to the required strength at the cable clamping, the clinching nuts are manufactured of steel type "S" (precision). The fillister head machine screws are made of brass.

2.5. Plating

Silver plating, applied to the female and male contacts under preceeding IPS contract, has been replaced by gold plating (23 + car) according to MIL-G-45204, type II, class 2.

Connector's hardware are cadmium chromated in accordance with Spec-QQ-P-416a; exception is made only for male guide pins, which are finished with 0.0002" thick nickel in order to minimize the binding and gauling during mating.

In regard to the cover finish, the whole assembly, except the clinching nuts and machine screws, are clear anodized in accordance with Spec. MIL-A-8625A. The clinching nuts and fillister head machine screws are cadmium chromated.

2.6 Preproduction Parts Inspection

The quality control system established at the Elco Corp., maintains an effective and economical quality control on the product. It is a system which insures that adequate control of quality is maintained throughout the entire process of manufacturing. All supplies and materials manufactured within the Elco Corporation, or produced from any other source, receives sufficient inspection to insure conformance with contractual requirements.

According to the inspection reports, some discrepancies were found in development of the male insulators. The right angle contacts 0.040 of inch in diameter, molded in place, were exposed from the base unevenly and in some cases were found to be out of the required position. Also, the flash on the boss side was evident. Recognizing the fact that the contacts are deformed inside of the insulator body, consideration was given to the transfer pressure, which might be too great. We felt that the

size and the shape of the openings through which the material enters the cavity of the mold are quite important to proper operation of the tool. The gates were increased and the new fabricated parts found to be acceptable by following report. The flash on the contact-pins was corrected with the help of the specially made deflashing tools.

In order to obtain preproduction approval on each of the contract items prior to Pilot Run production, the samples were assembled and released to the Test Lab. for evaluation.

2.7 Testing

The preproduction samples were submitted to the tests specified in paragraphs 3.1.3 through 3.1.5.4, and 4.1 through 4.5.4 of technical requirements SCL-6018 A, dated 26, July 1960. All this work was performed at Elco Laboratory in accordance with MIL-STD-202 B (test methods for electronic and electric component parts) under the surveillance of Miss. Gaber, U.S. Army Electronics Material Support Agency Field Engineer.

A general picture on types of tests performed, the sequence of applied testing and results by means of passed samples indicates a test summary table, shown below:

Test Group I

Test No	Title of Test	No. of Samples Tested	No. of Samples Passed
1	Visual Inspection	16	16
2	Insertion and Withdrawl	16	16
3	Contact Resistance	16	16
4	Insulation Resistance	16	16
5	Dielectric Withstanding Voltage (Sea Level)	16	16

Test Group II

1	Dielectric Withstanding Voltage (High Altitude)	2	2
2	Contact Life	3	3
2a	Insertion and Withdrawal	3	3
2b	Contact Resistance	3	3
3	Vibration	3	3
4 q	Insertion and Withdrawal	3	3
5	Contact Resistance	3	3
6	Salt Spray	2	2

Test Group III

1	Moisture Resistance (Insulation Resistance)	4	4
2	Thermal Shock	4	4
3	Contact Resistance	4	4

The sub-miniature packaging connectors successfully passed the tests to which they were submitted. A qualification report #00947 was prepared and released with all data sheets to U. S. Army Signal Corps Agency for approval.

In conclusion of this Qualification Testing Program the report states, that "all the connectors tested satisfactorily met the requirements as specified in SCL-6018A. There were a few minor exceptions such as the corrosion of the steel mounting washers, softness of the mounting pins and one broken contact due to vibration. Investigation of a more suitable material for both the washers and pins is in progress. One broken contact constituted only a small percentage of the contacts vibrated and this could have been due to undue strain on the contact which occured during wiring for continuity" (page 23).

The additional tests were performed for the covers. One test included salt spray resistance and the other dielectric withstanding voltage. There was no evidence of any corrosion action on covers upon completion of the salt spray test and there was no indication of a

voltage breakdown as a result of the 1,000 volts RMS, induced between the cover and the contacts.

2.8 Pilot Run

Pre-production samples and test data have been found to be acceptable to USASIMSA except for two conditions noted as follows:

(a) The split steel lock washers should be replaced by the same type of phosphor bronze.

(b) The male connector guide pins should be fabricated of non-magnetic, corrosion resistant metal which is hard enough to eliminate bending on insertion and withdrawal of the connector sections.

Permission was granted to initiate the Pilot Run on the connectors provided that the two above changes will be included in the product.

A Pilot Run is the production of approved component parts, in sufficient total quantity and at a production rate adequate to prove the tools and the manufacturing processes. It should provide data from which a sufficient and realistic level might be determined.

The following parts and quantities have been included in our production run, according to the contractual specification:

Item	Quantity	Description	Drawg. No.
1-2-1	500	Plugs with 7 contacts	6015.0110
1-2-2	500	Plugs with 9 contacts	6015.0120
1-2-3	500	Plugs with 11 contacts	6015.0130
1-2-4	500	Plugs with 15 contacts	6015.0140
1-2-5	500	Plugs with 19 contacts	6015.0150
1-2-6	500	Plugs with 23 contacts	6015.0160
1-2-7	500	Receptacles with 7 conts.	6014.0110
1-2-8	500	Receptacles with 9 cts.	6014.0120
1-2-9	500	Receptacles with 11 cts.	6014.0130
1-2-10	500	Receptacles with 15 cts.	6014.0140
1-2-11	500	Receptacles with 19 cts.	6014.0150
1-2-12	500	Receptacles with 23 cts.	6014.0160
1-2-13	225	Covers for 7 contacts	6004.9010
1-2-14	225	Covers for 9 contacts	6004.9020
1-2-15	225	Covers for 11 contacts	6004.9030
1-2-16	225	Covers for 15 contacts	6004.9040
1-2-17	225	Covers for 19 contacts	6004.9050
1-2-18	225	Covers for 23 contacts	6004.9060

In order to begin with the Pilot Run, the material on split washers was changed immediately to phosphor bronze and the soft brass guide pins were replaced by the pins made of the half hard material which were cold worked to 3/4 hard temper after machining.

No evidence of any corrosion action was found on phosphor bronze washers as a result of a salt spray retest.

2.8.1 Pilot Production Line

A Pilot Production Line is a minimum combination of all tools, dies, fixtures, prototype production and test equipment required to produce a component part at the rate specified in the contract.

Three types of component parts were under consideration in our work: plugs, receptacles and covers. The assembly operations within each group are similar in spite of the differencies in overall dimensions and number of contacts standard to each size.

In setting up the actual assembly procedures, a study was performed to determine the functions required for

all groups, methods of assembly, sequence of operations and the time required to assemble a component unit. The results of our work are listed below, marking each operation with a capital letter:

A. Insertion of the contacts into the receptacle body - manually.

Quantity of Assembled Receptacles	Number of Contacts Per Receptacle	Total Operation Time in Hrs.	Rate Receptacles Per Hour
600	7	5.2	115
600	9	7.7	78
600	11	10.4	58
600	15	11.4	52
577	19	17.8	32
586	23	22.1	26

49641 contacts have been inserted at the time of 74.6 hrs, including total quantity of assembled receptacles. The average time for the insertion of one contact into the cavity was found to be 5.43 seconds.

B. Pulling and staking of the female contacts -

Method: Staking tool installed in an air operated press - 3407 receptacles - all sizes - used 16.6 hrs. of assembly time at the rate of 205 units per hour.

C. Straightening of wire hole tabs and cleaning the receptacles - manually.

3252 Units 23.8 Hrs. 136 Per Hr.

D. Printing with an applicable description.

Method: Semi-automatic vibratory marking tool.

Receptacles - all sizes.

3283 Units 23.8 Hrs. 138 Per Hr.

Plugs - all sizes.

2174 Units 15.9 Hrs. 137 Per Hr.

Covers - all sizes.

1753 Units 9.0 Hrs. 195 Per Hr.

E. Varnishing the Printing Areas - manually by use of a brush.

Receptacles - all sizes

4024 Units 27.9 Hrs. 144 Per Hr.

Plugs - all sizes

2867 Units 20.1 Hrs. 142 Per Hr.

Covers - all sizes.

1788 Units 7.3 Hrs. 245 Per Hr.

F. Mounting of the alignment hardware.

Method: Manually operated screw driver and socket wrench.

Receptacles - all sizes.

3542 Units 55.3 Hrs. 64 Per Hr.

Plugs - all sizes.

3042 Units 96.8 Hrs. 32 Per Hr.

G. Riveting of the stationary clamp into the top of the cover.

Method: Riveting tool installed in an Arbor Press.

Covers - all sizes.

1809 Units 24.3 Hrs. 74 Per Hr.

H. Staking the special nuts into the sides of the cover.

Method: Dimple tool installed in an air operated press.

Covers - all sizes.

1514 Units 19.8 Hrs. 76 Per Hr.

I. Clinching the nuts into the stationary clamp.

Method: Economy Tool operated by an Arbor Press.

Covers - all sizes.

1719 Units 7.7 Hrs. 223 Per Hr.

J. Cover's Finish - clear anodize.

K. Completion of the cover assembly with the moving clamp by the use of a fillister head mach. screw.

Covers - all sizes.

1618 Units 24.6 Hrs. 66 Per Hr.

Functions shown under A, D, G and F (only for plugs) are independent in assembly work and can be performed at the same time. All other operations require the sequence of operations.

2.8.2 Sequence of Operations

An optional sequence of operations is shown below in conjunction with the time required for each function per one component part with an average number of contacts. All functions correspond to the operations from preceeding paragraph 2.8.1 and are marked with the same reference letters.

2.8.2.1 Receptacles

Function:	Ass'y Time Per Unit:
Insert the contacts into the insulator body (A)	1.27 Minutes
Pull and stake the contacts in place (B)	0.29 Minutes
Check the straightening and cleanliness (C)	0.44 Minutes
Print the receptacle (D)	0.43 Minutes
Varnish the printing (E)	0.42 Minutes
Mount the hardware (F)	0.94 Minutes
TOTAL	3.79 Minutes

The average number of contacts is $\frac{7+9+11+15+19+23}{6} = 14$, and the insertion time per one contact is 5.43 sec., as shown under 2.8.1 (A).

Approximate assembly time per receptacle with average number of contacts is equal to -

3.79 Minutes

The following illustration gives a picture of the time variation for contact - insertion, depending on the connectors size:

	Ass'y Time Given in Minutes Per One Receptacle					
Number of Contacts	7	9	11	15	19	23
Operation 2.8.1 (A)	0.52	0.77	1.00	1.15	1.87	2.30

2.8.2.2 Plugs - All sizes.

Function:	Ass'y Time Per Unit:
Print the Plugs (D)	.43 Minutes
Varnish the Printing (E)	.42 Minutes
Mount the Hardware	1.87 Minutes
TOTAL	2.72 Minutes

Approximate assembly time per plug is equal to -

2.72 Minutes

2.8.2.3 Covers - All Sizes

Function	Ass'y Time Per Unit:
Rivet the stationary clamp to the top of the hood (G)	0.81 Minutes
Stake the special nuts (H)	0.79 Minutes
Press the clinching nuts (I)	0.27 Minutes
Print the covers (D)	0.31 Minutes
Varnish the printing (E)	0.24 Minutes
Mount the mounting clamp (K)	0.91 Minutes
TOTAL (LESS ANODIZING)	3.33 Minutes

Approximate ass'y time per cover is equal

3.33 Minutes

2.8.3 Pilot Run Inspection

A meeting was held at Elco Corp. on September 19, 1962, in the presence of Government Representatives (see 5.2), to establish an inspection level on Pilot Run items. It has been agreed to use the procedure as denoted below:

Group "A", Inspection per MIL-STD-105 table 3A, level 2, single sampling, A.Q.L. 1% major and 4% minor.

1. Visual and Mechanical.

Group "B", Inspection per MIL-STD-105 table 3B, level L7 single sampling A.Q.L. 1% major.

1. Insulation resistance
2. Dielectric withstanding voltage (sea level)
3. Contact resistance
4. Interchangeability (mate connectors)

Group "C" - Testing not required - Groups A,B,C per SCL-6018 A.

Test Results:

1. Connectors were found to conform visually and mechanically to the applicable specification.
2. The connectors passed the insulation resistance and dielectric withstand voltage tests.
3. Contact resistance exceeded the applicable requirements. It was found for:

7 Cont. Connectors	3.77 Milliohms in average
9 Cont. Connectors	3.51 Milliohms in average
11 Cont. Connectors	3.25 Milliohms in average
15 Cont. Connectors	3.41 Milliohms in average
19 Cont. Connectors	3.37 Milliohms in average
23 Cont. Connectors	3.70 Milliohms in average

4. The connectors passed the interchangeability test.

2.8.4 Marking and Shipping

The federal stock numbers for sub-miniature packaging connectors were assigned by U.S.A.S.S.A. after the item description data was found to be acceptable to this Agency. In the preparation of the item identification patterns a "Federal Standard No. 5A" was used.

The assigned stock numbers for packaging connectors are shown below with an addition of corresponding Elco part numbers and Government designation:

Item	Fed. Stock No.	Designation	Elco Part No.
1-2-1	5935-892-8912	SPC-200-MR-7	6015.0110
1-2-2	5935-892-8913	SPC-200-MR-9	6015.0120
1-2-3	5935-892-8914	SPC-200-MR-11	6015.0130
1-2-4	5935-892-8915	SPC-200-MR-15	6015.0140
1-2-5	5935-892-8916	SPC-200-MR-19	6015.0150
1-2-6	5935-892-8917	SPC-200-MR-23	6015.0160
1-2-7	5935-892-8928	SPC-200-FS-7-WT	6014.0110
1-2-8	5935-892-8924	SPC-200-FS-9-WT	6014.0120
1-2-9	5935-892-8925	SPC-200-FS-11-WT	6014.0130
1-2-10	5935-892-8926	SPC-200-FS-15-WT	6014.0140
1-2-11	5935-892-8927	SPC-200-FS-19-WT	6014.0150
1-2-12	5935-892-8929	SPC-200-FS-23-WT	6014.0160

Item	Fed. Stock No.	Designation	Elco Part No.
1-2-13	5935-892-8905	SPC-200-CC-7	6004.9010
1-2-14	5935-892-8906	SPC-200-CC-9	6004.9020
1-2-15	5935-892-8907	SPC-200-CC-11	6004.9030
1-2-16	5935-892-8908	SPC-200-CC-15	6004.9040
1-2-17	5935-892-8909	SPC-200-CC-19	6004.9050
1-2-18	5935-892-8910	SPC-200-CC-23	6004.9060

The Pilot Run items were packaged in accordance with commercial practice and in a manner that affords protection against corrosion, deterioration and damage during the shipment. The plugs and receptacles were located separately into standard Elco plastic bags by packing machine. The covers were stacked up on the stickey tape paper boards and then packed into the cartons.

Marking of the interior and shipping containers was done in accordance with MIL-STD-129B.

The Pilot Run items have been distributed according to the shipping instruction as follows:

370 each items 1 through 12, and 120 each items 13 through 18 to:

Oak Ridge National Laboratory
Box "X"
Oak Ridge, Tennessee
Attn: Mr. G. A. Holt

125 each items 1 through 12, and 100 each items 13 through 18 to:

Commanding General
U. S. Army Electronic Research
and Development Agency
Fort Monmouth, New Jersey
Attn: SELRA/SL-PEP
Mr. Weldon Lane

5 items each 1 through 12, and 5 items each 13 through 18 to:

Commanding General
U. S. Army Electronics Material Agency
225 South 18th Street
Philadelphia 3, Pennsylvania
Attn: SELMA-R2a
Mr. C. R. Iseminger

Prior to shipment all carton containers were final inspected by Navy Quality Assurance Representative and stamped with a Government Approval Seal.

2.8.5 Problems Encountered in Pilot Run Production

The problems encountered so far involve the 23 contact receptacle only. In the Pilot Run we were forced to apply the additional operations for these parts in order to bring the insertion and withdrawal forces within the

limits of applicable specifications.

According to the mating test requirements, the connectors shall not exceed a value equal to 1.0 times the number of contacts, in pounds, after ten unmonitored cycles, and the withdrawal force, shall be a minimum of 0.25 times the number of contacts and shall not exceed the measured insertion force.

Our 23 contact receptacles, being staked on the Denison Press of 2,000 lbs. capacity, exceeded the max. limits for insertion and withdrawal forces. It was necessary to undertake some corrective action and for this reason we have initiated an intensive study on the above problem. Due to the corrective action, two additional operations were under consideration: Brushing the connectors with a lubricant Elco No. PS-045 and/or sizing the contacts with the pin of proper diameter.

For experimental purpose, a number of the 23 contact connectors were divided into four groups. Each group consisting of six connector pairs, were submitted to a special test treatment. The measurements were recorded and summarized in form of the following tables:

Test Group I

The receptacle contacts were not sized; lubricant was applied only to the plugs by spraying, after the 11th cycle.

Connector Pair	1st. Cycle		11th Cycle		Lubricant + 5 Cycles		Contact Resistance After Lubricatio in Milliohms
	Insertion Lb.	Withdrawal Lb.	Insertion Lb.	Withdrawal Lb.	Insertion Lb.	Withdrawal Lb.	
# 20	34	35	33	30	24	25	3.83
# 21	37	35	28	29	25	25	
# 22	35	38	25	25	24	26	
# 23	37	40	26	30	25	28	3.80
# 24	35	37	25	30	24	26	
# 19	31	31	23	25			

Test Group II

The receptacle contacts were not sized; lubricant was applied only to the receptacles before the 1st cycle.

Connector Pair	1st. Cycle		11th Cycle	
	Insertion Lbs.	Withdrawal Lbs.	Insertion Lbs.	Withdrawal Lbs.
# 18	24	28	20	25
# 13	34	35	22	24
# 14	28	30	20	22
# 15	35	38	26	30
# 16	36	31	21	23
# 17	26	25	18	19

Test Group III

The receptacle contacts were sized with the 0.042 dia. pin and brushed with lubricant after 11th Cycle.

Results:

Connector Pair	1st. Cycle		11th Cycle		Lubricant + 5 Cycles		Contact Resistance After Lubrication in Milliohms
	Insertion Lbs.	Withdrawal Lbs.	Insertion Lbs.	Withdrawal Lbs.	Insertion Lbs.	Withdrawal Lbs.	
# 1	19	19.5	23	23			3.77
# 7	17	16	17	17			
# 26	23	18	23	30			
# 29	26	30	20	25	19	17	3.83
# 30	23	20	21	23	19	22	
# 28	26	31	27	31	19	16	

Test Group IV

The receptacle contacts were sized with .042 dia. pin and brushed with lubricant prior to first cycle.

Results:

Connector Pair	1st. Cycle		11th Cycle		Contact Resistance In Milliohms
	Insertion Lbs.	Withdrawal Lbs.	Insertion Lbs.	Withdrawal Lbs.	
# 3	16	20	16	17	
# 4	20	20	18	19	3.90
# 5	14	16	14	15	
# 6	15	19	14	16	3.77

Test group I indicates time insertion and withdrawal forces, which were found on receptacles with 23 contacts. Lubricant applied after 11th cycle decreased the above forces, but not sufficiently. A better picture is shown on the second table (Test Group II). Some connector pairs meet the applicable requirements, however not 100%. These results suggest a conclusion that the lubrication itself can be very helpful in some similar problems.

Test Group III illustrates the results obtained from sizing the contacts with 0.042" dia. pin. Some contacts were found to decrease the mating forces to desired limits, and some not.

Full satisfaction was received after application of sizing and lubrication, as shown on table IV. Therefore, to protect the best performance of Pilot Run, all 23 contact receptacles were submitted to the above treatment.

The procedure of manual brushing with lubricant is not complicated and the efficiency of this function was found around 380 units per hour. The manual sizing of the

contacts with a single pin is less convenient. This work must be done very carefully and by an experienced person, because improper withdrawal of the sizing pin, can result in an open contact.

For future production we will eliminate the sizing operation, either by decreasing the press force during the staking of the contacts into the insulator body, or by producing the female contacts with lower initial insertion and withdrawal forces.

In order to determine a proper size of pin for sizing operation, a number of pins with various diameters was tested. It was found that the sizing with a 0.042" dia. pin did not appear to have any practicular affect on the contact resistance.

2.9 Quality Control Manual

The specification of SCL-6018 covers the quality requirements for subminiature packaging plugs and receptacles. Some portions of above specifications indicating the quality disciplines for the subject connectors, are listed below:

(a) Grid Requirements - The termination for both the plug and receptacle shall be located on intersection points of a 0.050 inch modular grid. The terminations shall meet the requirements of SCL-6225.

(b) Polarization - A polarization feature shall be a part of each connector assembly to assure correct insertion.

(c) Alignment - Each connector shall have a feature which will insure proper alignment of contacts before mating.

(d) Method of Mounting - A method of mounting shall be provided to assure that the forces applied to mate and unmate the mounted connector are not transmitted through the printed wiring termination solder joints.

(e) Insertion & Withdrawal Force - The max. insertion force, in pounds, shall not exceed a value equal to 1.0 times the number of contacts, and the withdrawal force, in pounds, shall be a minimum of 0.25 times the number of contacts and shall not exceed the measured insertion force.

(f) Contact Resistance - The average contact resistance of all contacts measured shall not exceed 0.015 ohm and no individual contact shall have a resistance exceeding 0.030 ohm.

(g) Insulation Resistance - The insulation resistance shall be greater than 1,000 megohms.

(h) Dielectric Withstanding Voltage - For sea level - the test voltage shall be 1,000 volts rms, 60 cycles ac.; duration of application 60 seconds; for high altitude - 500 volts rms, 60 cycle ac; no disruptive discharge, evidenced by flashover, sparkover, or breakdown, shall occur as a result of the applied voltage.

(i) Vibration - The connectors after this test shall show no signs of fracture, loosening, deterioration, or interruption in circuit continuity.

(j) Moisture Resistance - Initial insulation resistance shall be greater than 1,000 megohms and the insulation resistance shall not be below 1 megohm after the indicated number of cycles.

(k) Thermal Shock - After this test, the connectors shall show no evidence of cracking or crazing of the body or other physical damage to the assembly.

(l) Salt Spray - Upon completion of the test, the connectors shall be examined for evidence of peeling, chipping or blistering of metal surfaces, or exposure of base metal. Guidance with regard to techniques of measurement shall be derived from MIL-STD-202 and common practice within the arts.

2.10 Production Planning - The Industrial Preparedness Study requires the ability to produce 5,000 completed units, male and/or female (not in balanced quantities) per five day week, of one eight-hour shift per day.

In having the information on the approximate time to assemble an average receptacle, plug or cover (see 2.8.2), we are able to determine the approximate overall time per one complete unit with an average number of contacts (value Q):

Average time per receptacle including the cover	7.12 min.
Average time per plug	2.72 min.
TOTAL	9.84 min.

Value Q = $\frac{9.84}{2} = \frac{4.92}{}$

Therefore 5,000 units x 4.92 min. = 24 600 min/week = 410 hrs / week.

When 40 hrs. is provided for one operator per week then:

$\frac{410 \text{ hrs./week}}{40 \text{ hrs./week}}$ = 10.25 or approximately ten operators.

One foreman is required to perform the planned assembly work.

In addition to the above calculations, attention must be paid to a supply of the component parts in sufficient quantities for assembly work or in other words, to the productability of the existing manufacturing tooling.

Most of the parts are produced on Screw Machines of high speed rate or on progressive dies, which are capable of manufacturing many more items than are provided for in planning. Only the insulator bodies are the parts with lower production rate.

How many insulators of each type and each size can be produced per five day week, of one eight hour shift per day, using the existing molds, indicates the illustration shown below, on the basis of Pilot Run production:

MOLDING	PART NO.	PRODUCTION DAILY	PRODUCTION WEEKLY
7 Contact Receptacle	6004.3012	250	1250
23 Contact Receptacle	6004.3062	250	1250
9 Contact Receptacle	6004.3022	250	1250
19 Contact Receptacle	6004.3052	250	1250
11 Contact Receptacle	6004.3032	250	1250
15 Contact Receptacle	6004.3042	250	1250
7 Contact Plug	6005.9010	100	500
9 Contact Plug	6005.9020	100	500
11 Contact Plug	6005.9030	95	475

MOLDING	PART NO.	PRODUCTION DAILY	PRODUCTION WEEKLY
15 Contact Plug	6005.9040	90	450
19 Contact Plug	6005.9050	85	425
23 Contact Plug	6005.9060	80	400

The plug-contacts are being molded in place and the need for additional operations decreased the productivity of the molds. Mold description was given under paragraph 2.3.1.

Due to the planned production rate, the following quantities have to be submitted on a weekly basis:

For Plugs	2650	Moldings
For Receptacles	2650	Moldings
TOTAL	5300	Units, including 5% allowance.

According to the capability of our molds, 7 presses have to be employed to supply the moldings on the current rate.

No problem exists for hood's fabrication, because the tool is able to produce 200 hoods per hour.

The above calculations have been established to provide the basic information in regard to the production of sub-miniature packaging connectors with covers. Significant gains in production potential will be achieved, when the additional feeder system and electric operated wrenches will be employed to facilitate the semi-automatic assembly.

3. Conclusions - As a result of our Engineering and Development work based upon the connectors from previous IPS Contract, we have fabricated a line of the sub-miniature packaging connectors, a line of the parts which were processed in a careful and workman like manner, in accordance with good design, and sound practics.

We have fulfilled all requirements in Design Development and Engineering. We have modified the tooling from the preceeding contract, we have fabricated the new special tooling, we have introduced the new materials and we have corrected the plating. Our test data was found to be acceptable by USAEMSA and our preproduction samples have been received for production approval.

Furthermore, a Pilot production line was established, a time study was determined, and Pilot Run was performed for the purpose of proving out a manufacturing process and utilizing production methods and techniques. Quality Control Checks of pertinent points in production were applied and delivery of Pilot Run was completed.

We have ended up with the planning for mass production of the sub-miniature packaging connectors with and without the covers, for printed one sided circuitry and for cable interconnection, for the rack and/or panel mounting.

4. Publications and Reports

4.1 Design Review Meeting

Attended By:	Date:	Reporting:
Miss. Mary Tumelty, Contracting Officer, USASSA	7 Sept.1961	A. Wontorsky
Mr. Carl Iseminger, Project Engineer, USASSA		
Mr. Weldon Lane, USASRDL		
Miss. Rita Gaber Field Engineer, USASIMSA		
Mr. Joe Cichetti, QCR		
Mr. Joe Bell, SQCR		
Mr. H.E. Ruehlemann, V.P. Engineering & Research, Elco Corp.		
Mr. Samuel Weiss, Mgr. Government Contracts, Elco Corp.		
Mr. Herman Gordon, Supervisor of Development Engineering, Elco Corp.		
Mr. Joe Horwitz, Test Engineer, Elco Corp.		
Mr. Frank Menta, Co-ordinator, Elco Corp.		
Mr. Alexander Wontorsky, Project Engineer, Elco Corp.		

4.2 Pilot Run Test Meeting

Attended By:	Date:	Reporting:
Miss. Rita Gaber, Field Engineer, USASIMSA	19 Sept. 1962	A. Wontorsky
Mr. Joe Cichetti, Inspector, Navy QAR		
Mr. Joe Horwitz, Test Engineer, Elco Corp.		
Mr. Frank Menta, Co-ordinator, Elco Corp.		
Mr. Alexander Wontorsky, Project Engineer, Elco Corp.		

4.3	Month Reported:	Reporting:
1st. Monthly Progress Report	June, 1961	A. Wontorsky
2nd. Monthly Progress Report	July, 1961	A. Wontorsky
3rd. Monthly Progress Report	August, 1961	A. Wontorsky
4th. Monthly Progress Report	September, 1961	A. Wontorsky
5th. Monthly Progress Report	October, 1961	A. Wontorsky
6th. Monthly Progress Report	November, 1961	A. Wontorsky
7th. Monthly Progress Report	December, 1961	A. Wontorsky
8th. Monthly Progress Report	January, 1962	A. Wontorsky
9th. Monthly Progress Report	February, 1962	A. Wontorsky
10th. Monthly Progress Report	March, 1962	A. Wontorsky
11th. Monthly Progress Report	April, 1962	A. Wontorsky

	Month Reported:	Reporting:
12th. Monthly Progress Report	May, 1962	A.Wontorsky
13th. Monthly Progress Report	June, 1962	A. Wontorsky
14th. Monthly Progress Report	July, 1962	A. Wontorsky
15th. Monthly Progress Report	August, 1962	A. Wontorsky
16th. Monthly Progress Report	September, 1962	A. Wontorsky
17th. Monthly Progress Report	October, 1962	A. Wontorsky
18th. Monthly Progress Report	November, 1962	A. Wontorsky
19th. Monthly Progress Report	December, 1962	A. Wontorsky

4.4

Letter-type Report	October, 1961	A. Wontorsky
Letter-type Report	December, 1961	A. Wontorsky
Letter-type Report	January, 1962	A. Wontorsky
Letter-type Report	March, 1962	A. Wontorsky
Letter-type Report	April, 1962	A. Wontorsky
Letter-type Report	June, 1962	A. Wontorsky
Letter-type Report	July, 1962	A. Wontorsky
Letter-type Report	September, 1962	A. Wontorsky
Letter-type Report	October, 1962	A. Wontorsky
Letter-type Report	November, 1962	A. Wontorsky

4.5

First Quarterly Report	9 June to 9 Sept. 1961	A. Wontorsky
Second Quarterly Report	9 Sept. to 9 Dec. 1961	A. Wontorsky
Third Quarterly Report	9 Dec. 1961 to 9 Mar. 1962	A. Wontorsky
Fourth Quarterly Report	9 March to 9 June 1962	A. Wontorsky
Final Report	June 1961 to Dec. 1962	A. Wontorsky

5. Identification of Personnel

Name:	Position:	Approximate Hours of Project:
Herman Gordon	Supervisor of Development Engineering	376
Alexander Wontorsky	Project Engineer	1624
Andrew Sobota	Tool Engineer	85
Joe Horwitz	Test Engineer	30
Ray Cassel	Tool Designer	98
Peter Slobodzian	Tool Designer	12
William Cunningham	Mold Designer	35
Henry Horn	Designer	27
Ralph Fisher	Draftsman	168
Michael Lukawsky	Draftsman	26
George Huntzinger	Test Technician	97
Robert Lang	Test Technician	15
Steve Granoff	Test Technician	14
Jerry Miller	Model Maker	25
Mary Klechiner	Ass'y Technician	27
Michael J. Vahey	Tool Maker	147
George Richard	Tool Maker	18
Warren Patterson	Tool Maker	16
Pilot Run Production		540
Mold Run Production		680

PARTS LIST FOR TOOLING RI

(DRAWING IDENTIFICATION)

1

U.S. ARMY SIGNAL CORPS

CONTRACT Nº DA-36-039-SC-85361

ORDER Nº [illegible]-PP-61-61-91

SUBMINIATURE PACKAGING CONNECTORS

IN ACCORDANCE WITH SCS-93

D.E.O. 615
(DEVELOPMENT ENGINEERING ORDER)

ASSEMBLIES

Nº	CONTRACT ITEM Nº	CONTRACT DESIGNATION	DESCRIPTION	SIGNAL CORPS DRAWG Nº	SIGNAL CORPS REV	ELCO DRAWG Nº	ELCO REV	QUANTITY REQ'D
1	1-2-1	SPC-200-MR 7	MALE CONN. 7 CONT	ES-C 183236 GR I		6015.0110	2	500
2	1-2-2	MR 9	9	GR II		20	2	500
3	1-2-3	MR 11	11	GR III		30	2	500
4	1-2-4	MR 15	15	GR IV		40	2	500
5	1-2-5	MR 19	19	GR V		50	2	5[illegible]
6	1-2-6	MR 23	23	GR VI		60	2	[illegible]
7	1-2-7	SPC-200-FS-7 WT	FEMALE CONN. 7 CONT	ES C 183237 GR I		6014.0110	3	5[illegible]
8	1-2-8	FS 9 WT	9	GR II		20	3	5[illegible]
9	1-2-9	FS 11 WT	11	GR III		30	3	5[illegible]
10	1-2-10	FS 15 WT	15	GR IV		40	3	5[illegible]
11	1-2-11	FS 19 WT	19	GR V		50	3	5[illegible]
12	1-2-12	FS 23 WT	23	GR VI		60	3	5[illegible]
13	1-2-13	SPC-200-CC-7	COVER & C CL. 7 CONT	ES C-183235 GR I		6014.1[illegible]10	2	[illegible]
14	1-2-14			GR II		20	2	[illegible]
15	1-2-15	11	11	GR III		[illegible]	2	2[illegible]
16	1-2-16	15	15	GR IV		[illegible]	2	[illegible]
17	1-2-17	[illegible]	[illegible]	GR V		[illegible]	2	2[illegible]
18	1-2-18	23	23	GR VI		[illegible]	2	2[illegible]
				TOTAL PER CONTRACT				

MALE INSUL

500 500 500 500 500 500 500 500 500 500 500

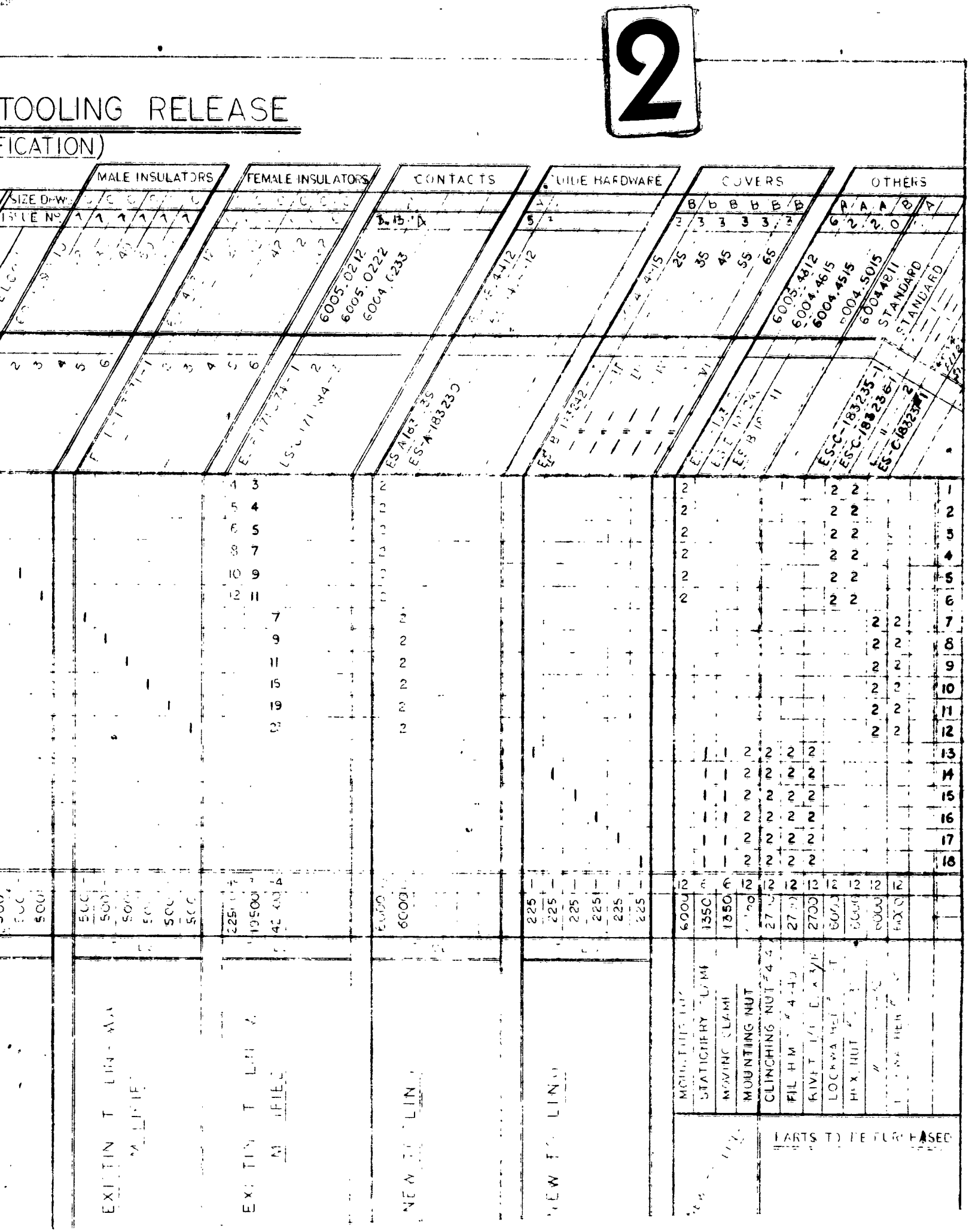
* [illegible] ** [illegible] CONTACT [illegible] *** [illegible] CLAMP

REMARKS

1. THE ADDITIONAL DWG. # BK-03237 ILLUSTRATES THE INTERCHANGEABILITY OF THE GUIDE PINS WITH THE COAXIAL R.F. CONNECTORS.
2. [illegible]

TOOLING RELEASE

FICATION)



SUBMINIATURE PACKAGING CONNECTORS

[illegible] SCS-93

D.E.O. 6115
(DEVELOPMENT ENGINEERING ORDER)

REVISION

No	CONTRACT ITEM No	CONTRACT DESIGNATION	DESCRIPTION	ASSEMBLIES: SIGNAL CORPS DWG No	REV	ELC No	REV	QTY REQ'D
1	1-2-1	SPC-200-MR 7	MALE CONN. 7 CONT	ES-C 183236 GR I		6015.0110	2	500
2	1-2-2	MR 9	9	GR II		20	2	500
3	1-2-3	MR 11	11	GR III		30	2	500
4	1-2-4	MR 15	15	GR IV		40	2	500
5	1-2-5	MR 19	19	GR V		50	2	[illegible]
6	1-2-6	MR 23	23	GR VI		60	2	[illegible]
① 7	1-2-7	SPC-200-FS-7WT	FEMALE CONN 7 CONT	ES C 183237 GR I		6011.0110	[illegible]	[illegible]
8	1-2-8	FS 9 WT	9	GR II		20	3	[illegible]
9	1-2-9	FS 11 WT	11	GR III		30	3	[illegible]
10	1-2-10	FS 15 WT	15	GR IV		40	3	[illegible]
11	1-2-11	FS 19 WT	19	GR V		50	3	[illegible]
12	1-2-12	FS 23 WT	23	GR VI		60	3	[illegible]
② 13	1-2-13	SPC-200-CC-7	COVER & CL. 7 CONT	ES C-183235 GR I		[illegible].10	2	[illegible]
14	1-2-14	[illegible]	[illegible]	GR II		20	2	[illegible]
15	1-2-15	11	11	GR III		[illegible]	2	[illegible]
16	1-2-16	15	15	GR IV		[illegible]	2	[illegible]
17	1-2-17	[illegible]	[illegible]	GR V		[illegible]	2	[illegible]
18	1-2-18	23	23	GR VI		[illegible]	2	[illegible]
				TOTAL PER CONTRACT				

500 500 500 500 500 500 500 500 500

* [illegible] CONN. [illegible] ** CONT= CONTACT *** CL= CABLE CLAMP

NOTES:

1. THE ADDITIONAL DWG. # BK-03237 ILLUSTRATES THE INTERCHANGEABILITY OF THE GUIDE PINS WITH THE COAXIAL R.F. CONNECTORS;
2. [illegible]

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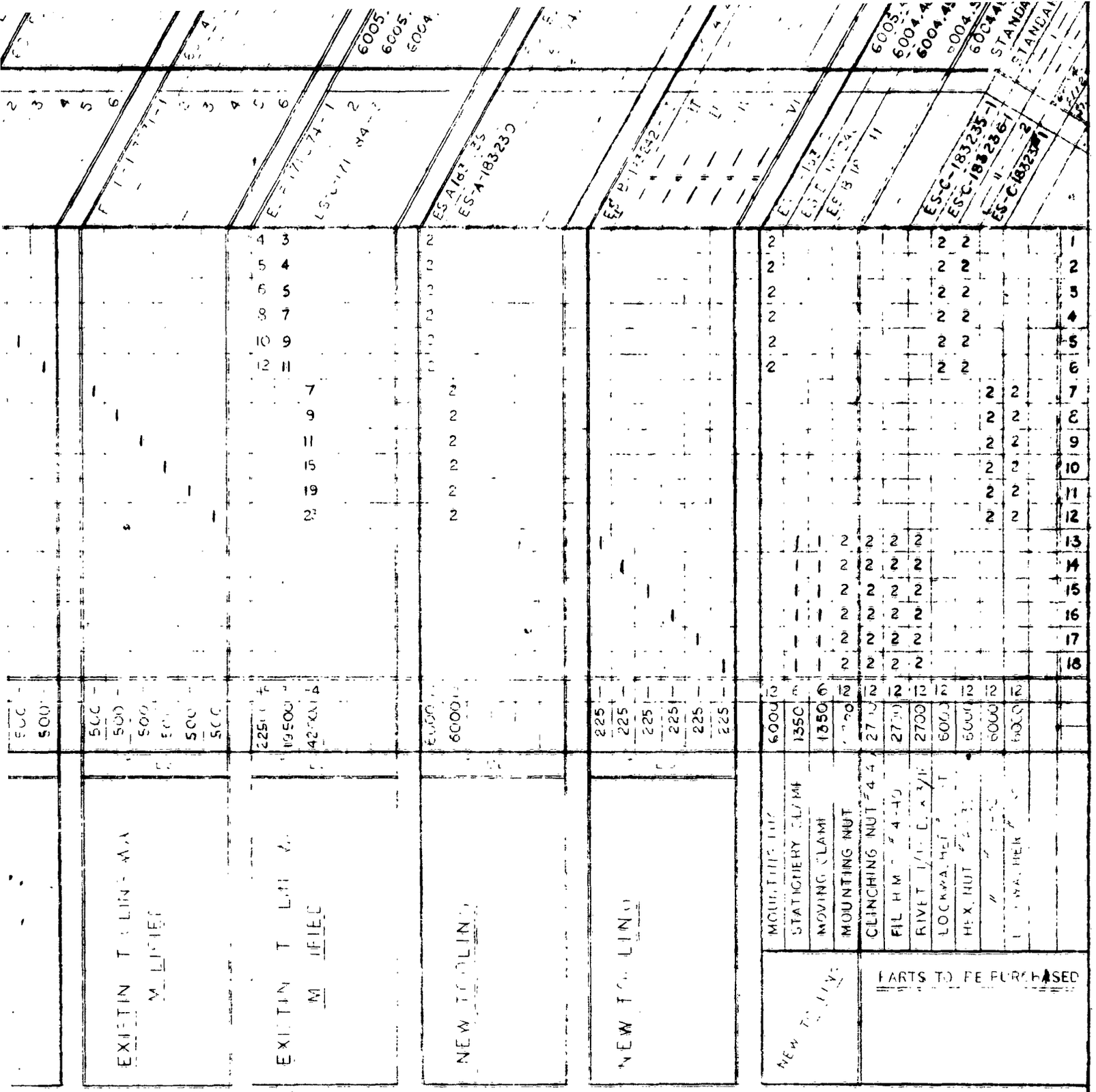

4

ELCO CORP.

FINALIZED: 5.12.62

REV. 3.

CK-03488

5 | 4 | 3

DIMENSIONS ARE IN INCHES, AND INCLUDE THICKNESS OF PLATING.

ALL SCREW THREADS TO BE CLASS 2 FIT (AM. STD.) UNLESS OTHERWISE

D

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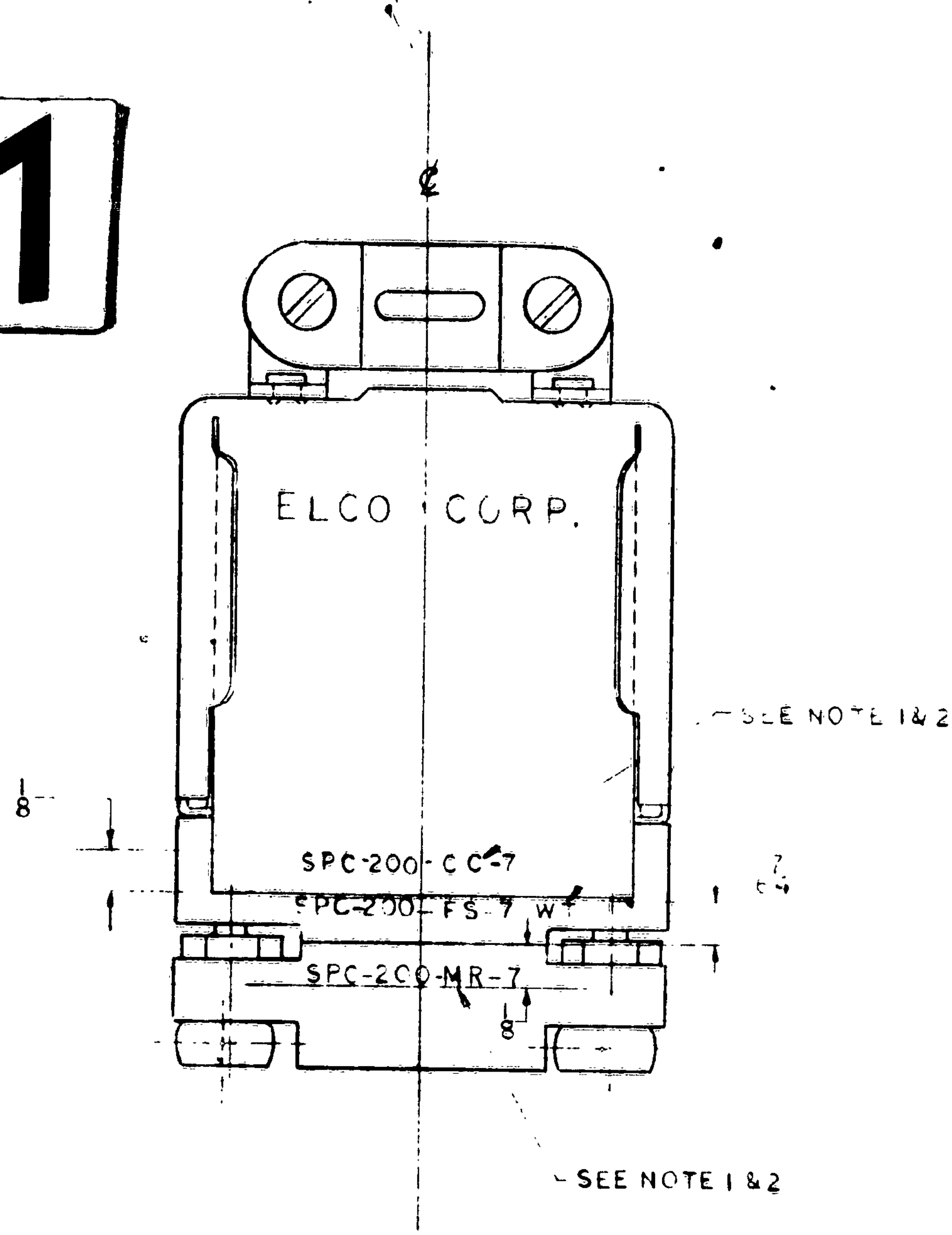

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B

MARKING	
ASSEMBLY PART NO.	
6015.0110	
6015.0120	
6015.0130	
6015.0140	
6015.0150	
6015.0160	
② 6014.0110	
6014.0120	
6014.0130	
6014.0140	
6014.0150	
6014.0160	
② 6004.9010	
6004.9020	
6004.9030	
6004.9040	
6004.9050	
6004.9060	

NOTES:
1. MARK IN
WITH B
CLEAN V
MARKIN

A

ISSUE NUMBER		
	Issue 2. ECO 1267 SPC-200-FS-7-CCT was SPC-200-FS-7 & T SPC-200-CC-7 (SH.) SPC-200-CC-7 8/31/62 H.C.	ISSUE 3. ECO #1250 REVISED NOTE 2 10/2/62 H.C.

MATERIAL	FINISH	GROSS WT. PER M. PCS.	NET WT. PER M. PCS.

J. H. WEIL CO., PHILA. 5 | 4 | 3

THREADS TO BE CLASS 2 FIT (AM. STD.) UNLESS OTHERWISE SPECIFIED. DO NOT SCALE DRAWING.

B6014.91

D C B A

MARKING DESCRIPTION TABLE

	ASSEMBLY PART NO.	TYPE	NUMBER OF CONTACTS	MARKING DESCRIPTION
	6015 0110	MALE	7	SPC-200-MR-7
	6015.0120	— " —	9	— " — -MR-9
	6015 0130	— " —	11	— " — -MR-11
	6015 0140	— " —	15	— " — -MR-15
	6015 0150	— " —	19	— " — -MR-19
	6015 0160	— " —	23	— " — -MR-23
②	6014, 0110	FEMALE	7	SPC-200-FS-7-WT
	6014.0120	— " —	9	— " — -FS-9-WT
	6014.0130	— " —	11	— " — -FS-11-WT
	6014.0140	— " —	15	— " — -FS-15-WT
	6014 0150	— " —	19	— " — -FS-19-WT
	6014.0160	— " —	23	— " — -FS-23-WT
②	6004, 9010	COVER	7	SPC 200 - CC-7
	6004.9020	— " —	9	— " — -CC-9
	6004.9030	— " —	11	— " — -CC-11
	6004.9040	— " —	15	— " — -CC-15
	6004.9050	— " —	19	— " — -CC-19
	6004.9060	— " —	23	— " — -CC-23

2

TE 1 & 2

NOTES:

1. MARK IN .06 CHARACTER'S (TYPE 18) IN POSITION SHOWN WITH BLACK MARKING INK TT-I-558. COAT MARKING WITH CLEAN VARNISH MIL-V-173 TYPE II. MARKING TO CONFORM TO MIL-STD-130.

TOLERANCES ON FRACTIONAL DIMENSIONS UNLESS OTHERWISE SPECIFIED		
DECIMAL DIMENSIONS	FRACTIONAL DIMENSIONS	ANGULAR DIMENSIONS
UP TO ¼	± .005	± .005
ABOVE ¼ TO 6	± .005	± .005
ABOVE 6 TO 24	± 1/32	± .010
ABOVE 24	± 1/32	± .015

MARKING DESCRIPTION

DRAWN BY [illegible] DATE 7-23-62.

CHECKED BY [illegible] SCALE 2:1

APPROVED BY [illegible]

ELCO CORPORATION "M" ST. BELOW ERIE AVE. PHILADELPHIA 24, PA.

DWG. NO. B6014.91